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YELLOW LAKE, BURNETT COUNTY, WISCONSIN

Pacific Northwest Environmental Research
Laboratory

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June 1975

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NATIONAL EUTROPHICATION SURVEY

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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ON
YELLOW LAKE
BURNETT COUNTY
WISCONSIN
EPA REGION V
WORKING PAPER No. 68

WITH THE COOPERATION OF THE
WISCONSIN DEPARTMENT OF NATURAL RESOURCES
AND THE
WISCONSIN NATIONAL GUARD

JUNE, 1975

CONTENTS

	Page
Foreword	ii
List of Wisconsin Study Lakes	iv, v
Lake and Drainage Area Map	vi
Sections	
I. Introduction	1
II. Conclusions	1
III. Lake Characteristics	3
IV. Lake Water Quality Summary	4
V. Literature Reviewed	9
VI. Appendix	10

FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nation-wide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS*

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

* The lake discussed in this report was included in the National Eutrophication Survey as a water body of interest to the Wisconsin Department of Natural Resources. Tributaries were not sampled, and this report relates only to the data obtained from lake sampling.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Wisconsin Department of Natural Resources for professional involvement and to the Wisconsin National Guard for conducting the tributary sampling phase of the Survey.

Francis H. Schraufnagel, Acting Assistant Director, and Joseph R. Ball of the Bureau of Water Quality, and Donald R. Winter, Lake Rehabilitation Program, provided invaluable lake documentation and counsel during the Survey. Central Office and District Office personnel of the Department of Natural Resources reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper series.

Major General James J. Lison, Jr., the Adjutant General of Wisconsin, and Project Officer CW-4 Donald D. Erickson, who directed the volunteer efforts of the Wisconsin National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

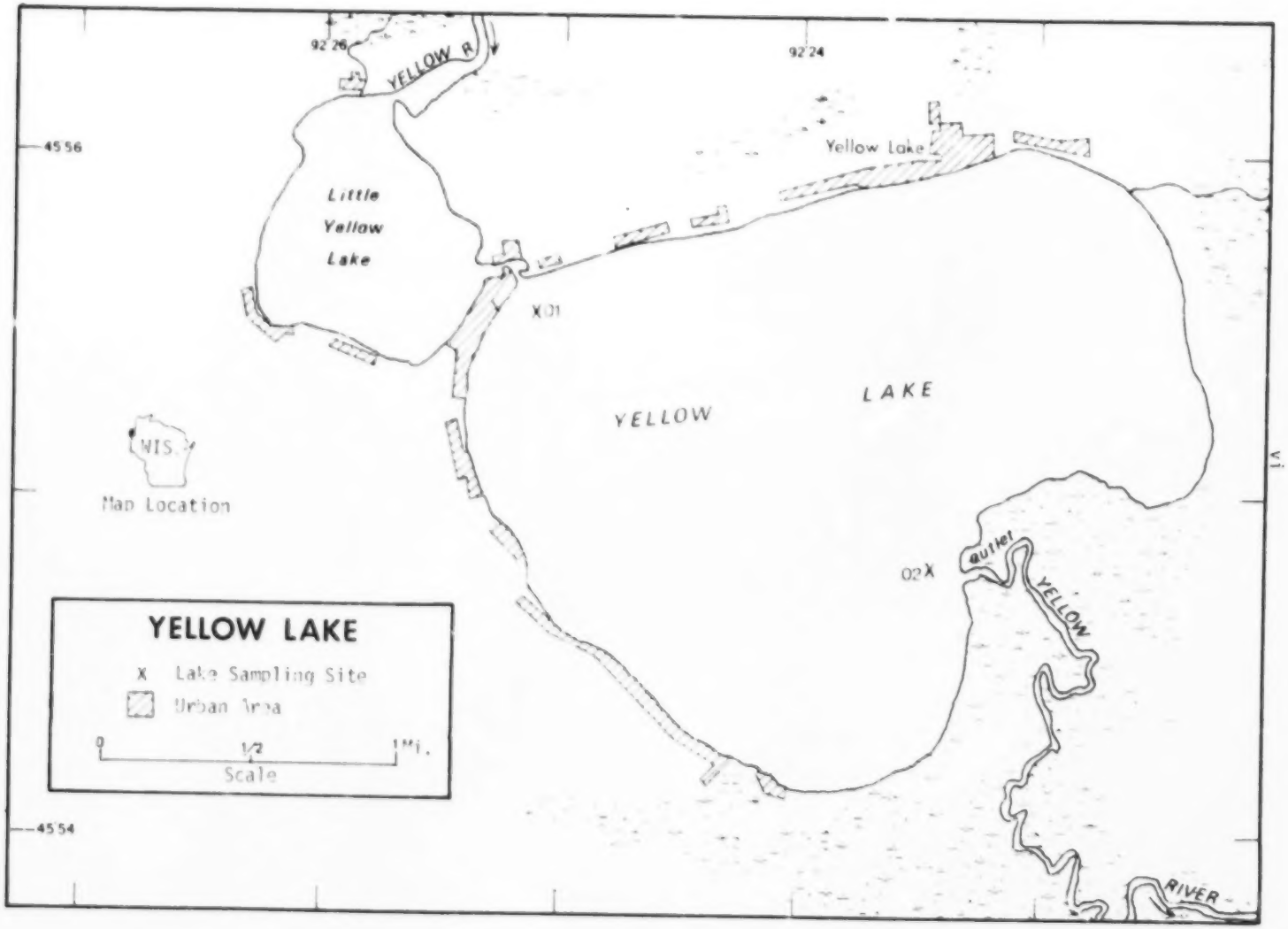
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF WISCONSIN

LAKE NAME	COUNTY
Altoona	Eau Claire
Beaver Dam	Barron
Beaver Dam	Dodge
Big Eau Pleine	Marathon
Browns	Racine
Butte des Morts	Winnebago
Butternut	Price, Ashland
Castle Rock Flowage	Juneau
Como	Walworth
Crystal	Vilas
Delavan	Walworth
Eau Claire	Eau Claire
Geneva	Walworth
Grand	Green Lake
Green	Green Lake
Kegonsa	Dane
Koshkonong	Jefferson, Rock, Dane
Lac La Belle	Waukesha
Middle	Walworth
Nagawicka	Waukesha
Oconomowoc	Waukesha
Okauchee	Waukesha
Petenwell Flowage	Juneau
Pewaukee	Waukesha
Pigeon	Waupaca
Pine	Waukesha
Poygan	Winnebago, Waushara
Rock	Jefferson
Rome Pond	Jefferson, Waukesha
Round	Waupaca
Shawano	Shawano
Sinnissippi	Dodge

LAKE NAME	COUNTY
Swan	Columbia
Tainter	Dunn
Tichigan	Racine
Townline	Oneida
Trout	Vilas
Wapogassett	Polk
Wausau	Marathon
Willow	Oneida
Winnebago	Winnebago, Fond Du Lac, Calumet
Wisconsin	Columbia
Wissota	Chippewa
Yellow	Burnett


92°26'
YELLOW R.
92°24'
45°56'
Yellow Lake
Little
Yellow
Lake
X01
YELLOW
LAKE
WIS.
Map Location
outlet
02X
YELLOW
RIVER
YELLOW LAKE
X Lake Sampling Site
Urban Area
0
1/2
1 Mi.
Scale
45°54'

YELLOW LAKE

STORET NO. 5576

I. INTRODUCTION

Yellow Lake was included in the National Eutrophication Survey as a water body of interest to the Wisconsin Department of Natural Resources. Tributaries were not sampled, and no wastewater treatment plants impact the lake (Schraufnagel, 1975). Therefore, this report only relates to the lake sampling data.

II. CONCLUSIONS

A. Trophic Condition:

Survey data indicate Yellow Lake is eutrophic. Of the 46 Wisconsin lakes sampled, 22 had less mean total phosphorus, 20 had less mean dissolved phosphorus, 13 had less mean inorganic nitrogen, 25 had less mean chlorophyll a, and 18 had greater mean Secchi disc transparency. Dissolved oxygen was depressed with depth (to 20 feet) at sampling station 1 in August, 1972.

Survey limnologists observed algal blooms in June and August; and Yellow Lake has been chemically treated a number of times to control aquatic weeds and at least once to control algae (Lueschow, 1972).

B. Rate-Limiting Nutrient:

The algal assay results show that Yellow Lake was nitrogen limited at the time the sample was taken (11/03/72). The lake data indicate nitrogen limitation in June and August as well.

III. LAKE CHARACTERISTICS

A. Morphometry†:

1. Surface area: 2,287 acres.
2. Mean depth: 18.9 feet.
3. Maximum depth: 32 feet.
4. Volume: 43,236 acre-feet.
5. Mean hydraulic retention time: 154 days*.

B. Precipitation**:

1. Year of sampling: 33.4 inches.
2. Mean annual: 28.1 inches.

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† Ball, 1973.
* Based on normal outflow of 142 cfs estimated by Blackman and Sather (1966).
** See Working Paper No. 1, "Survey Methods, 1972".

IV. LAKE WATER QUALITY SUMMARY

Yellow Lake was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two stations on the lake and usually from two or more depths at each station (see map, page vi). During each visit, a single depth-integrated (15 feet or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the last visit, a single five-gallon depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll *a* analysis. The maximum depths sampled were 24 feet at station 1 and 21 feet at station 2.

The results obtained are presented in full in Appendix A, and the data for the fall sampling period, when the lake essentially was well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix A.

A. Physical and chemical characteristics:

		FALL VALUES (11/03/72)		
Parameter	Minimum	Mean	Median	Minimum
Temperature (Cent.)	5.2	5.2	5.2	5.3
Dissolved oxygen (mg/l)	9.7	9.9	9.9	10.0
Conductivity (μmhos)	160	170	173	175
pH (units)	7.3	7.4	7.4	7.5
Alkalinity (mg/l)	72	73	73	74
Total P (mg/l)	0.035	0.071	0.050	0.162
Dissolved P (mg/l)	0.020	0.026	0.021	0.049
NO_2 + NO_3 (mg/l)	0.060	0.065	0.060	0.080
Ammonia (mg/l)	0.040	0.052	0.050	0.060
		ALL VALUES		
Secchi disc (inches)	36	59	59	78

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
06/26/72	1. Microcystis	1,628
	2. Dinobryon	868
	3. Chroococcus	597
	4. Melosira	506
	5. Flagellates	326
	Other genera	777
	Total	4,702
08/27/72	1. Anabaena	1,356
	2. Melosira	244
	3. Fragilaria	108
	4. Flagellates	99
	5. Mallomonas	45
	Other genera	354
	Total	2,206
11/03/72	1. Dinobryon	2,412
	2. Flagellates	1,131
	3. Cryptomonas	327
	4. Fragilaria	251
	5. Cymbella	226
	Other genera	1,532
	Total	5,879

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (µg/l)
06/26/72	01	11.9
	02	10.1
08/27/72	01	3.9
	02	4.5
11/03/72	01	35.1
	02	16.6

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.035	0.119	3.3
0.006 P	0.041	0.119	3.1
0.012 P	0.047	0.119	3.2
0.024 P	0.059	0.119	3.1
0.060 P	0.095	0.119	3.2
0.060 P + 10.0 N	0.095	10.119	46.6
10.0 N	0.035	10.119	16.0

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the primary productivity of Yellow Lake was moderately high at the time the sample was taken (11/03/72). There were no significant increases in yields with increases in phosphorus until nitrogen was also added.

The marked increase shown when nitrogen alone was added and when added with phosphorus indicates that Yellow Lake was nitrogen limited at that time.

The lake data indicate nitrogen limitation at the other sampling times as well; the N/P ratios were 9/1 in June and 8/1 in August, and nitrogen limitation would be expected.

V. LITERATURE REVIEWED

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VI. APPENDIX

Appendix A

Physical and chemical data

STORET RETRIEVAL DATE 74/09/30

557601
45 55 30.0 092 25 00.0
YELLOW LAKE
55 WISCONSIN

11EPALES 2111202
5 0006 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/26	08 55	0000	20.9	10.3	66	140	8.40	82	0.050	0.060	0.017	0.013
72/08/27	11 00	0000			54	173	7.70	84	0.060	0.200	0.057	0.034
	11 00	0004	20.0	6.3		180	7.60	80	0.060	0.210	0.065	0.041
	11 00	0015	19.8	5.4		182	7.50	81	0.060	0.290	0.078	0.043
	11 00	0020	19.7	3.1		180	7.25	77	0.080	0.520	0.177	0.033
72/11/03	08 45	0000			58	175	7.50	74	0.070	0.060	0.035	0.020
	08 45	0004	5.2			175	7.50	73	0.060	0.050	0.043	0.021
	08 45	0015	5.3	9.7		175	7.40	73	0.060	0.050	0.048	0.020
	08 45	0024	5.2	10.0		170	7.40	72	0.060	0.060	0.052	0.021

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/26	08 55	0000	11.9J
72/08/27	11 00	0000	3.9J
72/11/03	08 45	0000	35.1J

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/09/30

557602
45 55 00.0 092 23 30.0
YELLOW LAKE
55 WISCONSIN

11EPALES 2111202
5 0018 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/26	09 20	0000	20.1		78	190	8.50	84	0.060	0.080	0.020	0.015
	09 20	0017	19.0	8.2		195	8.10	82	0.050	0.070	0.016	0.011
72/08/27	11 15	0000			36	180	8.05	81	0.070	0.230	0.093	0.044
	11 15	0004	20.0	9.1		175	8.00	82	0.060	0.220	0.086	0.052
	11 15	0015	19.7	6.6		170	7.60	82	0.070	0.270	0.073	0.045
	11 15	0021	19.5	8.8		175	7.60	81	0.060	0.250	0.098	0.039
72/11/03	09 05	0000			59	165	7.30	72	0.060	0.040	0.162	0.049
	09 05	0004	5.2	9.9		160	7.30	72	0.080	0.050	0.086	0.025

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/26	09 20	0000	10.1J
72/08/27	11 15	0000	4.5J
72/11/03	09 05	0000	16.6J

J VALUE KNOWN TO BE IN ERROR